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THE PUBLIC AND THE CANCER PROBLEM[1]

By Dr. JAMES EWING

DIRECTOR, MEMORIAL HOSPITAL, NEW YORK

PUBLIC interest in the cancer problem is now at the highest point in history. Evidences of this interest appear on all sides and many occasions. The radio audience listens to grave references to cancer about as frequently as the average public taste for reality will endure. In one state ninety radio talks on cancer were delivered in one week. Nearly all classes of magazines find that their clientele will accept some, even several, serious discussions of cancer every year. In the yellow journals and so-called health magazines preposterous tales about the nature and cure of cancer are eagerly consumed in proportion to the unintelligence of the readers, while the emotional susceptibilities of the ignorant are fed by hideous devices depicting the ravages of the cancer dragon. Pseudo medical journals not infrequently decry against the standard methods of treatment of the medical profession and lay open a broad field for the exploitation of the public by numerous cancer charlatans. Many books, some serious, others incompetent, attempt more comprehensive messages mostly on the nature and social significance of cancer, but an adequate popular treatise on cancer yet remains to be produced and is urgently needed.

While the public interest rests ultimately on human experience with the disease, the radical change in public sentiment during the past twenty-five years and the advancing standard of general knowledge are largely due to the efforts of the American Society for the Control of Cancer, and other similar organizations in other countries, which have labored systematically and rather effectively to spread the knowledge of the main facts about cancer, emphasized the necessity of early diagnosis, stressed the warning signs of the major forms of the disease and in every way endeavored to establish an intelligent progressive attitude toward

[1] Evening Lecture before the National Academy of Sciences, Washington, April 25, 1938.

the cancer problem. This society has now built up local branches in every state and in most large cities of the country, and has contributed to the aroused interest in cancer as a public health problem by city, state and federal health agencies. It has so far failed to reach any considerable proportion of the non-reading public, but advances into this territory are slowly being accomplished by discussions in public schools and in some cities by personal canvasses of the lower classes conducted mainly by women. Women have always taken a prominent part in the movement for the control of cancer. The successful organization of the Women's Field Army of the American Society, bringing together over 100,000 women in one brief campaign, is an impressive illustration of the power of organized effort, especially by women, in public health movements. The Women's Field Army is one of the most significant efforts yet made in the history of cancer control in this or any country, and promises results of much significance. It is the privilege and duty of every intelligent woman to join its ranks.

Notwithstanding all past efforts the public knowledge of the practical aspects of cancer is still very superficial, tinged with emotion, distorted by unwarranted fear, restricted by inherent complexities of the subject and definitely limited by its obscurities, but it is steadily improving. Already in some localities the death rate from some forms of accessible cancer is beginning to decline, as a result, one may believe, of advancing public intelligence. Within the medical ranks there is a similar record of aroused interest, and more serious recognition of the scope of the cancer problem and of the variety and complexity of the agencies which must be set in action before one may speak of cancer control. The last 35 years have seen the growth of an immense, well-codified and rapidly circulating technical literature, the organization of local, national and international cancer societies and congresses, the systematic presentation of cancer programs in important medical meetings, improvements in the facilities for cancer service in general hospitals, the erection of broadly organized cancer institutes in many cities. An entirely new and comprehensive science, radiology, has been brought into existence, and is being applied through a vast number of competent specialists and a complex and elaborate machinery with startling new and beneficent results in the diagnosis and treatment of cancer. Perhaps the most significant change in the attitude of the medical profession is the present frank recognition of the deficiencies of medical knowledge about cancer and its treatment, as well as delinquencies in the application of well-known facts, and the general conclusion that effective study and treatment of cancer may no longer be considered the occasional task of the general practitioner or surgeon, but constitutes a highly complex medical specialty. Indeed, it may safely be said that cancer has become recognized as one of the most important and most progressive departments of medicine, as it is also the most fundamental problem of biology. This is the age of cancer progress, and since medical eras do not last indefinitely the medical profession is resolved to maintain at the highest level the momentum now gained in this field.

Accordingly, medicine is now calling freely for aid from the sciences, and if one surveys the organization of the modern cancer institute one finds representatives of many branches of science, physics and biophysics, chemistry and biochemistry, biology and genetics, botany and zoology, pathology and bacteriology, as well as all branches of medical art. In addition, the operation of a well-ordered cancer hospital involves not a little attention to statistical science, psychology, economics and sociology. These ramifications of the interest in cancer, which reach into many branches of human knowledge, form a broad basis which assures sound progress, but at the same time become a definite menace, because when every type of investigation claims relation to cancer, the resources become dissipated over too vast a territory and are apt to lose practical value. Since all classes of the public, educated and uneducated, professional and lay, scientific and political, have become more or less cancer-conscious it is not a matter of surprise that governments, state and national, have been taking a serious interest in the problem and have devoted large sums of money to cancer projects, creating special departments for study, service and research, and even in some instances showing a modern disposition to take command of the whole movement. Indeed, the present status of public interest in cancer has now reached a stage of emotional excitement, at times bordering on hysteria, encouraging impatient demands for progress and tending to lead to hastily considered programs and projects, which if they are not wisely chosen may lead to bitter disappointment and end in general public distrust.

Many experienced observers believe that it is time to inquire critically whether the public interest in cancer is intelligent and is being directed along sound lines or whether it is largely emotional and uncritical, whether the resources that are being poured into this field with increasing liberality are well controlled or largely wasted, and whether the medical profession is wisely organized for its work, or comparatively disorganized as some critics assert, and whether the present state of knowledge of cancer and of the sciences on which that knowledge depends justifies the large hopes and urgent demands for sensational progress which the public are now indulging.

The general public, a large proportion of the medical profession and some scientific men believe that cancer is a single disease like syphilis or tuberculosis, and that its control involves much the same methods. What the public wants is a cure for disseminated cancer and it is assumed that this cure will follow the discovery of the so-called "cause of cancer." These notions are erroneous. Cancer is not a single disease, but a great group of diseases dependent on a universal property of animal cells. The causes of malignant growth include all the classes of forces known in nature, and the malignant growth process in cancer is as obscure as the nature of growth itself. Even if the nature of the cancer process were fully explained, there is no assurance that such knowledge would place us in control of the process. General pathologists will hesitate to concede that a disease which has spread over many organs and systems of the body, producing serious structural changes, can be arrested and the body restored to a serviceable condition even if life be prolonged. Thus the main bases of the public hopes about cancer are unsubstantial or false, and until they are replaced with sounder ideas, the public will mislead itself.

Many serious missteps in the history of cancer and in its present situation are traceable to the above misconceptions on the part of the public. In America and elsewhere in the past and at the present time very liberal support to cancer projects has come from men of large means, who have resolved to strike directly at the cause and cure of cancer. These worthy philanthropists fall into several classes. One class has listened to the fervid tales of pseudo scientific adventurers or outright imposters, who begin by decrying the methods of orthodox medicine, overemphasizing so-called medical intolerance, asserting their own scientific knowledge and vision, and displaying a plan of procedure which to the uninitiated benefactor seems plausible, and thus securing ever-increasing confidence and support as misinterpreted reports of alleged partial successes begin to be gathered. It is not necessary to accuse either party of frank dishonesty. The benefactor knows nothing about medicine and the pseudo-scientist knows nothing about cancer, and both cordially deceive the other. Certain well-known projects of this class have grown to enormous proportions, involving the expenditure of millions of dollars, deceiving thousands of patients, surviving repeated public exposures, migrating from one misused territory to other virgin soils, but often gaining steadily in support from a small proportion of misguided souls in and out of medicine and reputable society. One of the chief sources of active support comes from a class of the socially elect, who perceive an opportunity of helping the persecuted scientist and possibly acquiring notoriety from the expected connection with a sensational piece of news when the new remedy finally triumphs. In one instance the "scientist," after escaping from the officers of the law down a fire escape in his pajamas, shortly appears at fashionable tea parties in Florida, later establishes quarters in New York, moves to London with less success, but gains a footing in a European laboratory. In another instance the scientist, after surviving several devastating exposures, finally lands in one of the most prominent laboratories of this country, where it requires two years before his stealthy methods and utter incompetence are demonstrated. Inquiring into the psychology of the benefactors of this class it appears that the gambling spirit is the basic motive, but only complete ignorance of the popular sort permits this motive to persist over so many disillusions. In certain other cases the benefactor was said by his friends to be mentally unsound. In all cases the fuel on which this fire feeds is the despair of the advanced cancer victim.

Another group of philanthropists are animated by the desire to find a cure for cancer and give liberal or even elaborate support to projects conceived and directed by unattached physicians, who are honest and orthodox but who have little or no knowledge of cancer. The benefactors are generally men of high intelligence but poor sagacity. The number of such projects now in existence is considerable, and the amount of money involved reaches a large total. Newspaper publicity marks the initiation of such projects, attracts for a time a large number of patients and continues to serve as an abnormal stimulus, although repudiated by the parties concerned. The methods employed are loosely ethical and a certain amount of scientific talent may be involved, but publications tend to be limited to the semi-medical press or to private communications. The promoters do not venture to present their work to their medical peers. The life of such projects is often rather tenacious and depends on the degree of isolation of the promoter and the patience and loyalty of the benefactor. This class of semi-scientific cancer cures forms a most disturbing chapter in cancer research in this and other countries. It diverts much money from reliable projects, deludes thousands of cancer victims and encourages the public appetite for sensational discoveries. The public should recall that men do not gather figs from thistles, and that no first-class medical discovery ever came from uninstructed persons.

Finally the determination to go after the cause and cure of cancer has been the impelling motive in the creation of some of the most important bequests now available in cancer research, and the feeling that sensational discoveries are imminent dominates the activities of some of the highest official scientific or-

ganizations. Thus the worthy donor of one of the largest gifts hopes, by greatly increasing the number of workers, to hit by chance the fortunate lead. Another donor urges the immediate investigation of the more appealing cancer cures announced in the newspapers. The sane and sagacious director of another outstanding organization was recently replaced by the appointment of a more modern, less informed, but more popular and more imaginative investigator, whose record includes the most brilliant fiasco in the history of modern cancer research.

I have referred in some detail to these various current sources of support of cancer research because they seem to reflect the prevailing attitude of the American public toward the cancer problem. They reveal that the popular approach to this great subject is highly emotional, which perhaps is not to be deprecated, but at the same time it is gravely lacking in intelligent comprehension of the nature of the problem, of the results which may reasonably be expected to come from laboratory research and of the methods which must be adopted, if real progress is to be secured. It is clear that large resources are being ineffectively employed, or futilely dissipated in the pursuit of topics which belong essentially in the pure sciences and have no connection with cancer. Well-meaning philanthropists must be warned that the odds are overwhelmingly against any one who listens to the fervid tales of great discoveries and undertakes to support the projects of visionary pseudo-scientists who know nothing about cancer and have no standing in the cancer world. The emotional parlor socialist who champions the supposed neglected and persecuted cancer genius is a pernicious influence in society. Even the more carefully considered schemes which involve the distribution of grants-in-aid, small sums from large foundations given for short periods over a very wide field, have demonstrated their limitations, and in fact have created conditions which in the experience of accredited directors of cancer research are almost intolerable. This system calls for an undignified resort to salesmanship by the directors of research laboratories who are compelled to support their claims for aid by promising rather more than they can expect to accomplish. The system attracts to the cancer field a great number of uninstructed workers who accomplish nothing of importance, but become a burden to the system. The opportunity of establishing careers for competent men who may possibly produce results of value once every five or ten years is excluded. The real problems of cancer are not to be elucidated by transient sporadic exploits of men mainly interested in other subjects. The outstanding contributors in cancer have all been men who enjoyed a broad foundation and who labored steadfastly for many years on competently conceived and skilfully conducted investigations. The system of grants-in-aid has been of substantial value in some other fields, but in cancer research its record has been mainly one of alleviating the working conditions in many laboratories, and in maintaining the general level of activity, but it has produced nothing of outstanding value. Accordingly it is the considered opinion of the directors of the established cancer laboratories in Europe and America that the system is to be disapproved and should be reorganized.

Disappointed by the paucity of results from cancer research and impressed by the sensational advances in industrial research and sharing the popular misconceptions of the nature of cancer problems, some critics, and especially the science editors, have asserted that modern cancer research is not well organized, that the workers do not cooperate, that secrecy and jealousy prevail in its ranks, that duplication of effort exists, that investigations are not broadly and competently designed, and that if the methods of industrial research were adopted, the problems of cancer would shortly be revealed as comparatively simple like those in the industrial field and in the simple sciences. One enthusiastic editor has declared that if he had a million dollars and the support of leaders in the industrial field he would solve the problem of the secret of cancer in five years. These assertions must be vigorously rejected. There is no better organized department of human endeavor than modern cancer research under the conditions provided. The whole cancer world is promptly informed of every new development in any part of the scientific world, by means of a comprehensive literature and very numerous local and international congresses and constant interchange of workers. The most friendly relations exist. There is need of repetition and more repetition of all new contributions in the biological field, for the genius of biological processes is infinite variation. It is evident that the science editors do not comprehend cancer problems and are not familiar with the history of the knowledge of cancer nor of the revolutionary progress that has been made in the past thirty-five years.

Nevertheless, the science editors are correct in suspecting that cancer research is not broadly organized and that if the conditions existing in industrial research were introduced, much greater progress would result. The resources available in industrial research are incomparably greater than in cancer. The steel industries of America alone spend $10,000,000 annually in research. This sum is little less than the total capital invested in cancer research in America. It is wholly beyond the capacity of any cancer laboratory to plan investigations on the scope and with the liberality enjoyed by industrial organizations. One of the chief

reasons is the fact that the main sources of support for cancer, outside of certain few institutions whose resources are now fully occupied in many directions, comes from foundations giving small grants in aid of small projects for short periods. This is the very antithesis of the policy of industrial research, which provides unlimited sums for extended periods for highly trained workers who are permanently assured of their positions. The conditions existing in industrial research should be introduced into cancer research.

Even then there is little comprehension of the great complexity and vast scope of the many solvable problems in the cancer field and of the probably insolvable nature of the main problem of the secret of malignant growth. Consider the scope of the program required if a really comprehensive investigation of such a disease group as lymphosarcoma were undertaken. This is a comparatively frequent, very fatal, local or general disease of the lymphatic system. It is probably of infectious origin and essentially inflammatory nature, but often exhibits neoplastic properties, because of which it is classed with cancer. Its sub-varieties vary widely, some being acute and febrile, others prolonged, but nearly always fatal. Regarding its causation, essential nature and fundamental properties practically nothing is known, diagnosis is difficult and treatment is ineffective. No systematic investigation of this disease is being conducted anywhere. An adequate attack on the problem of lymphosarcoma would require an organization coordinating many of the medical sciences, as epidemiology, pathological anatomy, experimental pathology, clinical medicine, bacteriology, serology, immunology, endocrinology and roentgenology, and the work could be conducted only in a large general or special institution where there is abundant material, an adequate well-trained staff and aid from the pure sciences. An income of about $50,000.00 a year for an indefinite period would be required to finance such a project, or a capital of $1,500,000.00.

Yet there are serious difficulties in the path of such an undertaking. It would be difficult to find competent men willing to confine themselves mainly to a narrow field in which results might be few and far between. Syndicated research in medicine has not been very profitable. The careers and psychology of the workers must be considered. Promising side lines might well develop in the course of the investigation and draw the worker into other fields. Essential knowledge might come, not from the direct attack, but from some wholly unexpected source. Substantial salaries would be required to hold highly competent investigators. Nevertheless, from such an undertaking one could reasonably promise substantial additions to knowledge, improvements in methods of diagnosis and treatment, probably certain means of prophylaxis and a general elucidation of the whole problem not now possible from the present type of isolated and sporadic efforts. It would bring one department of cancer research more in line with industrial research. In my opinion it is worth a trial.

There are scores of other diseases in the cancer field, each with its own problems which would require the same elaborate treatment, if the methods of industrial research are introduced. The scope of such an undertaking seems to have wholly escaped our critics. If society is determined that there must be more progress in the medical control of malignant neoplastic disease, it must be prepared to embark on a program of material support and scientific organization vastly broader than has yet entered the minds of philanthropists, government officials and most workers in the cancer field.

We come now to consider the position of the modern cancer research institute devoted to investigation of the fundamental problems of cancer. Of these there are one or more in nearly every large country, but the total number is not large. They represent medicine's best effort and carry its main hope for a solution of the so-called cancer problem, including the ultimate nature of malignant growth and a cure for disseminated cancer. During the past forty years these laboratories have been the main source of a great body of knowledge, including the transplantability of lower animal tumors, the existence of a form of immunity to cancer, the influence of heredity, the peculiar fermentative metabolism of most cancer tissue (Warburg), the influence of embryonal cell extracts on growth (Spemann), the influence of vitamins and other growth-stimulating agents, the existence of peculiar neoplastic diseases of fowl transmissible by cell-free viruses (Rous), the part played by hormones in the inception of tumors, the experimental production of tumors by a great variety of agents and the existence of highly potent cancerigenic chemicals. This great body of new knowledge has for the first time in history cleared away much of the mystery of the process and permitted a rather comprehensive and satisfying conception of the general significance of malignant growth in the animal kingdom. It has led steadily to the conclusion that the forces responsible for malignant growth are inherent in the cell and that the problem of cancer is essentially the same as that of normal growth.

What fundamental cancer research has not accomplished is to provide knowledge of practical value to the cancer patient, to furnish a cure for disseminated cancer or even to extend the control of cancer in the human being. It is extremely disappointing to those who have witnessed this modern era of fundamental research to have to acknowledge the paucity of prac-

tical results for the human being suffering from cancer. Yet during this same period there have been revolutionary advances in the diagnosis and treatment of cancer which have vastly improved the outlook for the cancer patient. These advances have come from the labors of a great number of pathologists, physicians, surgeons, radiologists and technicians, who have worked faithfully to meet the flood of solvable problems that arise in the wards of the cancer hospital and which differ in each form of cancer. They have drawn constantly for aid on laboratory research and on the various pure and applied sciences, but in general they have been content to be hewers of wood and drawers of water. The most important source of aid in cancer treatment has undoubtedly come from the discovery of radium and x-rays and the science of radiology, but highly important has been the widened knowledge of the different forms of neoplastic disease and their natural history and complications and the greater specialization and better organization of cancer service. As an example of this progress one may point to the five-year cure rate for tongue cancer, which in the best clinics in the past twenty-five years has risen from 10 per cent. to 26 per cent. of all comers. Even more significant has been the elimination of several dangerous and ineffective operations in favor of radiation, which is comparatively free from morbidity and mortality. The importance of radiation as a palliative for advanced cancer can hardly be overestimated. It is not too much to say that radiation treatment of cancer is the outstanding contribution of medicine to humanity in the present century and outweighs all previous progress in this field.

The significance of this contrast between the results obtained by the two main branches of cancer research may not wisely be ignored by those in charge of the resources now being made available in increasing measure for cancer control. There is every reason to believe that history will repeat itself and that the record of the past forty years will be duplicated in the next forty years. If so, then it is unwise to multiply isolated fundamental research institutions dissociated from human contacts and the sound direction of clinical medicine, and manned by workers who have little knowledge of cancer. Otherwise we may be reminded in increasing degree of Lord Chesterton's reflection that "science is the noblest of the toys by which we maintain the youth of the race." Also it will prove unwise to multiply independent cancer research foundations, distributing small grants to a multitude of miscellaneous workers mainly interested in biology and chemistry, but impelled by financial opportunity to take an occasional glance at cancer. Otherwise we shall be reminded of another reflection of Lord Chesterton, who remarked that, "Much research reminds one of a blind man looking in a dark room for a black hat that is not there." Moreover, there is urgent need for much greater support and concentration of effort in the great number of existing cancer institutes and highly competent clinical organizations which are operated by men deeply immersed in all phases of the cancer problem, who are keenly alive to the opportunities for important fundamental progress and who in the past have contributed the great bulk of the new knowledge which has been transferred immediately to human needs. No one would question the necessity of abundant support of the fundamental investigations which have so brilliantly illuminated the theoretical problems of cancer. All that one can properly demand is a clear understanding of the real significance of the two branches of research and a wise balancing of resources between them. A first step in this direction is to rob fundamental cancer research of the glamor it enjoys in the public mind and to point out the source from which the public may expect relief from the ravages of cancer.

Having given a rather conservative estimate of the prospects of fundamenal cancer research, it is permissible to indulge one's imagination and offer a more optimistic picture of what may possibly be accomplished in the future. Chemotherapy has occupied a great many investigators for many years past, who have hoped to find a chemical agent which could injure or destroy cancer cells without killing the patient. The heavy metals, especially, have been chiefly used, but the results are practically negative, because no heavy metal possesses any special affinity to unite with cancer tissue which is nearly homogeneous with the normal tissues. The sensational effects of sulfanilamide on streptococcus infection and of arsenic in syphilis naturally arouse hopes that some such specific agent might be found for cancer, but both the syphilis organism and the streptococcus are alien to the body, and the cancer cell is not. It is difficult to find any reasonable basis for the hope that the direct chemical attack of the cancer cell will prove successful. Yet the numerous studies of the relation between molecular structure and physiological action are being extended over a wide field and may possibly bring to light some agent antagonistic to certain types of cancer tissue. An indirect chemical approach, however, appears to be much more reasonable. We now know that the growth of cancer is often dependent on the action of growth-stimulating substances, which are not themselves the nutritive molecule but enable the cell to appropriate the nutritive substance. In 1905 Ehrlich announced this doctrine of athrepsia, designating the growth stimulant as the X substance, but his optimistic prophecy of an early solution of the cancer problem based on this theory was not realized. The field of

growth-stimulating agents is now widening and includes vitamins, hormones and tissue cell extracts of undetermined nature. It may be possible to find chemical antagonists to these agents and thus indirectly limit the growth of some cancers. The most striking examples of spontaneous regression of disseminated cancer have been observed when such growth stimulants have been withdrawn from the body.

Chemical studies of cancer metabolism have carried us deeply into the secrets of the malignant growth process, and chemistry constantly threatens to resolve the whole mystery. When Warburg announced his discovery that cancer cells have lost the capacity to appropriate oxygen and obtain energy mainly by a fermentative metabolism with the production of great quantities of lactic acid it was hoped that the secret of malignant growth was about to be revealed. It was supposed that the cancer cell can survive without oxygen, but this is far from the fact, for cancer tissue is extremely vulnerable to lack of oxygen and suffers bulky necrosis from a slight reduction in blood supply. Efforts to supply oxygen or peroxidases artificially have been attempted on an elaborate scale in many countries, but without effect other than the peculiar intoxication of oxygen. The respiratory mechanism of the cancer cell is injured and it can not appropriate oxygen which is generally present in cancer tissue in normal or increased amount. All efforts to destroy the cancer cell by disturbing its peculiar metabolism have failed and seem likely to fail. Moreover, all malignant tumor processes do not exhibit this type of metabolism. It is said that Warburg has given up the study of cancer entirely and will devote himself for the next ten years to the question of cell respiration.

Physical chemistry has made many approaches to the cancer problem, but has failed to leave any definite impression on it. It has discussed the osmotic relations which permit the cell to absorb enormous quantities of nutriment, the influence of surface tension, and recently the subject of surface films. It has recorded the interesting electric phenomena which transpire in mitotic cells and growing cancer tissue, and it has contributed the intangible doctrine of mitogenic radiation. Its exponents are hopeful that this fascinating science may in time attract serious consideration as a method of elucidating the secrets of the biological process of malignant growth. The bioelectric theory of growth of Burr and Northrop has recently been applied to the study of mammary cancer of mice with interesting theoretical results. No doubt there are innumerable phenomena connected with the cancer process and yet to be recorded.

Spemann's discovery of embryogenic organizers and inducers has revealed a new class of growth-controlling cell products which may have an important bearing on the cancer problem. He found that extracts of embryonal cells, as of the neural crest, possess the capacity of inducing other indifferent tissue cells to produce neural tissue when injected into other portions of the embryo. These extracts not only stimulate growth, but determine its character, but they do not produce malignant growth. There are many phenomena in cancer which suggest the action of cell derivatives, which maintain and determine the character of the growth and which have not yet been isolated or identified. Murphy and his co-workers have made essential contributions in this field and determined many of the properties of these growth-stimulating and inhibiting cell extracts. In the group of fowl sarcomas cell extracts assume the property of active cancerigenic agents.

The parasitic theory of cancer has always adjusted itself to the current knowledge of microbiology, and to-day it takes the form of the virus theory, that cancer is a general disease caused by a filterable propagable microorganism. This theory is held by some eminent investigators whose views are based mainly on the fact that the fowl sarcomas are transmissible by a cell-free filterable agent. The exact nature of this virus is not yet fully determined, but the weight of evidence is in favor of the view that it is a chemical agent. The infectious nature of common warts has long been known and recently Shope found that the papilloma of the skin of wild rabbits is transmissible to other rabbits through a cell-free filtrate. Rous then found that this agent produces in domestic rabbits much more active growth of warts and that some of these after becoming fissured and ulcerated lead to a low-grade carcinoma. He then combined the action of benzpyrene and the rabbit virus, rubbing the chemical into the skin and injecting the virus into the blood stream and found the resulting warts to be far more vigorous than after the action of either agent alone, while many of the warts became malignant. This ingenious experiment suggests that multiple factors may be concerned in the origin of some cancers and that one of these agents may be a virus. This hypothesis deserves further pursuit and may very well result in the inclusion of viruses in the etiology of certain epithelial tumors in man. The infectious behavior of certain papillary tumors of the mucous membranes has long been recognized by clinicians.

The discovery of very active cancerigenic properties in the cyclic compounds derived from coal tar, by Kennaway and Cook, justifies the hope that a substantial number of human cancers may be assigned to this class of agents. Already the number of these cancerigenic chemicals is considerable, and the specific

property seems to extend over a variety of related molecular structures. Moreover, it is shown that many substances normally present in the body are closely related to the coal tar compounds, such as the sterols, bile acids and the sex hormones, and that these may exhibit cancerigenic properties after slight degradation. That such changes in normal animal secretions actually occur in the body is not known, but it is probable that the body possesses mechanisms capable of inducing them. A very wide range of activity of the various hormones and some vitamins in causing cell proliferation and precancerous changes has been established, and it is probable that hormones enter into the etiology of many forms of cancer, especially of the sex organs.

Thus has grown up within a few years an entirely new and a very broad field of investigation of chemical agents, inorganic and organic, as causes of cancer, in which a large part of the cancer world is busily engaged. This field seems sharply contrasted with the virus theory, but if the viruses should prove to be only a peculiar form of cell product, the two fields may eventually converge.

These are some of the many promising topics which now occupy the modern cancer research laboratory engaged in fundamental research into the causes of cancer. Never before has cancer research offered so many alluring leads, and one may reasonably hope that these studies may soon greatly illuminate the etiology of many forms of cancer, provide a basis of prevention, and even lead to the discovery of a specific cure for some varieties of malignant tumors. Yet there is no indication that the newer cancerigenic agents and mechanisms are of universal application. On the contrary they serve rather to sharpen the contrasts between the many different forms of cancer, and they have not yet been of any practical value in the treatment of human cancer. For such eagerly sought results we must look to an entirely different field of investigation.

Indulging now the same imaginative spirit applied to the outlook for fundamental cancer research, what may the optimist expect from the study of cancer in the human subject by the army of clinicians and pathologists? Doubtless the greatest advances are anticipated in the improvements in radiation therapy, by means of the supervoltage x-ray machines, running as high as one and a half to three million volts. With every increase in voltage there has been an improvement in therapeutic results in one form or another and it seems highly probable that this ratio will continue considerably further but not indefinitely. We may rather confidentially expect that some deep-seated and resistant tumors may yield to these newer combinations of voltage and intensity. It is clear that large amounts of artificially radioactive substances can be produced by the cyclotron or the supervoltage x-ray apparatus, but there are practical difficulties in employing these agents for the human patient, and too great hopes should not be indulged in this direction. It has been shown that neutrons have a somewhat more destructive action on tissue cells than radium rays, but whether this form of energy can be harnessed and will give more selective effects on tumor cells is quite uncertain. However, physical agents have been shown to have such remarkable power to control the growth of cancer that no one would place sharp limitations to their future scope. The search for adjuvants to radiant energy, physical and chemical, offers an important field of investigation. Finally, the numerous minor improvements in the use of present available agents and apparatus, such as the divided dose technique, and the limitation of size of portals have greatly advanced therapeutic results, and similar advances will doubtless continue without any major contribution from physics.

Of the highest importance are the observations being made constantly by clinicians and pathologists on the exciting factors, clinical varieties, course and complications and methods of prevention of the various forms of cancer in the human subject. It is the function of clinical medicine to find the solvable problems and turn them over to the proper experts for solution, and in no field is this relation more intimate than in cancer. For this reason cancer research progresses more rapidly when conducted under the stimulus and direction of the flood of problems arising in a cancer hospital. Under these circumstances the standard of service, the education of the physician and the results of treatment are maintained at the highest level and make progress. Hence we find that in the past thirty-five years the outlook for the cancer patient has been enormously improved, and in the future we may expect that the better organization of cancer service, the building of cancer hospitals and the specialization of cancer clinics in general hospitals, without any sensational announcements, will produce a steady advance in the cure rate. In these activities lies the sole personal interest of the present generation of the public in the cancer problem, and not in the vaguer realm of fundamental research.

From the foregoing review certain general conclusions may be drawn. The American public has acquired a lively interest in the whole subject of cancer control and this interest, if wisely controlled and directed, is capable of bringing results of the highest importance. It is evident that public opinion has largely determined the organization of cancer research and control in this country, but that available resources have been greatly dissipated because of mis-

conceptions and false hopes on the part of the public. It is therefore essential that public education regarding the general facts of cancer and the probable sources of relief from this disease be developed to the highest degree. Every American citizen should become acquainted with the main facts about cancer and especially with the early signs of its major forms. He should indulge in periodic examinations by a competent physician, running down suspicious signs, detecting and discarding cancer-forming habits and removing precancerous lesions. He should inquire into his personal hereditary tendencies, which occasionally yield valuable clues. For these ends he should join his local branch of the Cancer Control Society or the National Society, attend public discussions of this subject and lend his support to the whole movement. The little Danish Cancer Society has ten times as many members as the American.

If he is a physician, he should be cancer conscious and alert to detect the early signs of the disease in his patients, taking nothing for granted. He should maintain his education by constant reading, faithful attendance at meetings, and should cultivate a progressive attitude toward modern organization of service and methods of treatment. In the treatment of cancer he should employ his talents, but recognize his limitations and the necessity of special skill in special fields.

If he is a philanthropist, he will be exceedingly cautious about trusting his judgment as a layman in the support of individual cancer projects. If he is a man of large means and large ideas, he will not prefer to play a lone hand, but will throw his resources in with others in one of the established institutions devoted to service or research. The trustees of Cancer Foundations will continue their invaluable support of cancer research on a broad scale, but may do well to consider some of the constructive suggestions made for the purpose of making their services more effective.

As public health agencies become more identified with cancer control it seems very necessary that the work of municipal, state and federal groups should be carefully coordinated with each other and with voluntary hospitals. The states should proceed cautiously before committing themselves to an expensive program of building hospitals for the exclusive care of advanced and indigent cases. It is probably far better to rely upon the resources of the organized medical profession and develop facilities for adequate diagnosis and treatment of early cases in as many localities as necessary. Otherwise there will always be a superabundance of advanced cases. The Federal Government would do well to study carefully the experience of other nations in the support of cancer research and service, and not commit itself to an irreversible program, defects of which may become obvious only after years of misdirected efforts and expense. There are many who believe that the search for the cause and cure of cancer is far removed from any function or responsibility of government. Yet there are many formidable research projects and immediate practical needs for which the large resources of the federal treasury seem to be the only resort.

When all the forces centering on cancer control are well coordinated and effective, relief from cancer will still remain essentially a problem for the individual man or woman. Alertness of the individual in avoiding cancer-forming habits, in detecting the premonitory signs of the disease and in accepting adequate treatment as early as possible will always remain the only effective protection. Habits of moderation in eating and living and the cultivation of a certain fastidiousness about one's person are wise resolves if one wishes to avoid cancer. This philosophy is quite appropriate for the modern man, woman and child, for there is every indication that cancer will long continue the most frequent, the most lethal and paradoxically the most curable major cause of death.

SCIENTIFIC EVENTS

THE TRING ZOOLOGICAL MUSEUM

LORD ROTHSCHILD, who bequeathed his zoological museum to the British Museum, made the provision that the legacy be accepted as an annex of the museum to be used in a modified form for zoological research. A correspondent of the London *Times* gives the following description of the museum. The building stands on a freehold site of some three acres on the outskirts of the town of Tring, close to Tring Park. It began in 1889 with a cottage in which Lord Rothschild housed his insect collection, and now consists of a main building forming three sides of a square and a large annex. These buildings occupy more than half an acre, and the aggregate floor space is about an acre and a half.

The museum, on which Lord Rothschild is believed to have spent more than £500,000, contains a zoological collection, a library (chiefly zoological, and especially entomological, but also to some extent botanical) of 30,000 volumes, and many original paintings of mammals and birds. The establishment consists of exhibition galleries which have been open to the public, the average yearly attendance being about 15,000 and of a research section which has, as a rule, been available to students only.

In the public galleries the exhibits include some 2,000

mammal specimens, among them 13 gorillas, 25 chimpanzees, 228 marsupials and a very fine specimen of the extinct horse-like animal from South Africa, the quagga. The mounted birds number 2,400, and among them are examples of the great auk and other extinct birds, and the best existing collection, numbering 62, of cassowaries. Of these last many are "type specimens." There are also important series of kiwis, birds of paradise, and humming birds, as well as of reptiles (among them 144 giant tortoises), fishes and certain invertebrates.

In the research collections there are some 1,400 mammal specimens; and, though Lord Rothschild a few years ago sold the bulk of his unmounted birds to the American Museum of Natural History for a large sum, there still remain at Tring about 4,400 bird skins, some of which belong to extinct species. There is, moreover, a large collection of birds' eggs which contains two eggs of the great auk, and the best existing series of those of the extinct aepyornis of Madagascar.

There is a collection of lepidoptera numbering more than 2,000,000 specimens. Among these are numbers of type specimens (of the geometer moths alone there are more than 6,000), and numerous species are represented which are to be found in no other museum. There are, too, examples of a great many still undescribed species. The butterflies and moths are represented in many instances by specimens collected from every part of their known geographical range. The museum also houses a collection of Anthribidae (a family of beetles of some economic importance) which is the largest in existence and contains more than 1,600 type specimens.

It is hoped that the British Government will see its way to provide the extra funds which the trustees of the British Museum will need to enable them to accept and maintain this bequest.

ENLARGEMENT OF THE WORK OF THE SCHOOL OF ENGINEERING AT NORTHWESTERN UNIVERSITY

AN enlarged teaching and research program for the School of Engineering of Northwestern University has been announced which involves an increase in the faculty. Professor George A. Maney has been appointed administrative chairman.

Under the new program, which increases from 132 to 138 the number of hours required for graduation, the technical content of the engineering curriculum will be greatly increased, especially in the last two of the four years of study. Three additional professors will be added to the present staff, one each in civil, mechanical and electrical engineering.

The curriculum will include a considerable amount of study in the liberal arts and in business subjects, designed especially for the training of business executives in the engineering field. Each student w also be required to take one course in speech.

Swift Hall of Engineering, which was the gift Mrs. Gustavus F. Swift and her son, Edward F. Swi will be remodeled to effect a twenty-five per cent. i crease in laboratory space so that additional equipme in the electrical and mechanical fields can be accomm dated.

To carry out the new program, the university h authorized a fifty per cent. increase in the pres budget of the School of Engineering. The propos curriculum has been approved by the National Eng neering Council for Professional Development, and w become effective in the fall.

George A. Maney, who has been appointed acti dean of the school, has been for a number of ye professor of structural engineering. He received t degree of civil engineer from the University of Minn sota in 1911 and his master's degree from the Univ sity of Illinois in 1914. In engineering practice he h been primarily concerned with problems of design a research in the structural field. He was consulti engineer for the Santa Fé Terminal Building of Dall Texas, in 1922. He was also consulting engineer charge of the design and construction of the Miss sippi River highway bridge at Savanna, Illinois. P fessor Maney is the originator of the "slope-deflecti method" now widely used in reinforced concrete buil ing, and is co-author, with Professor J. I. Parcel, "Statistically Indeterminate Stresses." Last year h was awarded the Wason Medal of the American Co crete Institute for his research on the slope-deflecti method.

BUSINESS MEETINGS OF THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY

AN informal meeting of the managing editors of t Wistar Institute journals was held on April 22 at t Rittenhouse Club in Philadelphia. The institute w represented by Dr. Alfred Stengel, president of t Board of Managers, and Edmond J. Farris, fellow anatomy in charge of operations.

The following editors were present:

C. E. McClung, *Journal of Morphology.*

Davenport Hooker, *The Journal of Comparative N rology.*

Charles R. Stockard, *The American Journal of Anato*

Aleš Hrdlička, *American Journal of Physical Anth pology.*

E. Newton Harvey, *Journal of Cellular and Compa tive Physiology.*

John R. Murlin, *The Journal of Nutrition.*

The annual meeting of the Advisory Board of t institute was held on April 23. The work of the

itute during the year was reported by the staff and scussed by the board. The members of the Advisory oard present were:

E. G. Conklin, Princeton University.
R. G. Harrison, Yale University.
J. P. McMurrich, University of Toronto.
C. M. Jackson, University of Minnesota.
C. E. McClung, University of Pennsylvania.
H. D. King, The Wistar Institute.
C. R. Stockard, Cornell University Medical College.
Wm. C. Rose, University of Illinois.

The Board of Managers was represented by Dr. Alred Stengel, *president,* and Jansen Haines, *secretary.*

THE TWENTY-FIFTH ANNIVERSARY OF THE PETER BENT BRIGHAM HOSPITAL

On May 5, 6 and 7 a celebration of the twenty-fifth anniversary of the opening of the Peter Bent Brigham Hospital for the reception of patients was held at the hospital in conjunction with a reunion of graduates of the professional and nursing services of the hospital. The Peter Bent Brigham Hospital is closely affiliated with the Medical School of Harvard University, functioning as a teaching and research unit of that Medical School.

On each of the three days up to 10:30 A. M. various hospital demonstrations, ward visits and surgical operations were conducted. After this there was a program of scientific and nursing papers, more than one hundred in number, presented by graduates and present members of the hospital professional and nursing staff.

On the forenoon of May 7 there was a large public meeting at which the Rt. Rev. William Lawrence, bishop emeritus of the Episcopal Diocese of Massachusetts, gave the invocation; His Excellency Charles F. Hurley, Governor of the Commonwealth, gave the greetings of the state; His Honor Maurice J. Tobin, mayor of Boston, the greetings of the city of Boston, and Dr. Dean Lewis, first surgeon-in-chief *pro tempore* of the Peter Bent Brigham Hospital, surgeon-in-chief of the Johns Hopkins Hospital, the greetings of the medical profession; President James B. Conant, Harvard University, the greetings of the university. Dr. Henry A. Christian, physician-in-chief of the Peter Bent Brigham Hospital and Hersey professor of the theory and practice of physic in the Harvard Medical School, made an address entitled "A Hospital Comes to Town—The Story of the Peter Bent Brigham Hospital in Boston"; Dr. Elliott C. Cutler, surgeon-in-chief of the Peter Bent Brigham Hospital and Moseley professor of surgery in the Harvard Medical School, an address entitled "A Surgeon Looks at the Record," and Dr. C. Sidney Burwell, physician at the Peter Bent Brigham Hospital and dean of the Faculty of Medicine of Harvard University, one entitled "The Future of the Hospital." The benediction was pronounced by the Rt. Rev. Francis L. Phelan, chancellor of the Archdiocese of Boston. These exercises were followed by a luncheon on the hospital grounds for all invited guests.

On each afternoon of these three days tea was served on the hospital lawn. On the evening of May 5 a musical comedy was given at the hospital by the resident professional staff. On the evening of May 7 there was a dinner for four hundred at the Vanderbilt Hall at the Harvard Medical School, followed by a dance at Longwood Towers, Brookline. At all these events the graduates were the guests of the trustees of the Peter Bent Brigham Hospital.

DEDICATION OF THE FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA

Ceremonies attending the dedication of the Franklin Institute, Philadelphia, will be held on May 19, 20 and 21. On the first day the theme will be "Franklin —Patriot and Man." At dawn guns will be fired over the Schuylkill River. Registration will open at the institute at 9 A. M., after which a heroic marble statue of Benjamin Franklin, executed by James Earle Fraser, will be unveiled and representatives of the British, French and Canadian Governments will place wreaths at the foot of the statue. The ceremonies will be followed by military displays and maneuvers on Benjamin Franklin Parkway. There will be a tea and reception in the afternoon for cabinet officers, foreign representatives, state governors, local officials, delegates and other distinguished guests, and in the evening the Honorable Daniel C. Roper, Secretary of Commerce, will make the principal address at a dinner of the Poor Richard Club.

On Friday, May 20, half-hour lectures on pure science will begin at 10 A. M. in the morning and at 2:30 P. M. in the afternoon, to commemorate Franklin as philosopher and educator. Luncheon will be served at one o'clock. The following speakers will take part in the program:

Sir James C. Irvine, principal and vice-chancellor, University of Saint Andrews, Aberdeen; Dr. C. E. K. Mees, director, Research Laboratory, Eastman Kodak Company; Dr. Gilbert N. Lewis, dean, College of Chemistry, University of California; Dr. George D. Birkhoff, Harvard University, and Dr. Forest Ray Moulton, permanent secretary, American Association for the Advancement of Science; Dr. Arthur L. Day, director of the Geophysical Laboratory, Carnegie Institution; Dr. Louis Martin, director, The Pasteur Institute, Paris; Dr. Thomas H. Morgan, California Institute of Technology, and Dr. Merritt L. Fernald, Harvard University.

Lectures on applied science centering around the theme "Franklin—Printer and Business Man" will be given from ten to twelve on Saturday. The speakers will be:

Dr. W. E. Wickenden, president of the Case School of Applied Science, Cleveland; Dr. Willis R. Whitney, vice-president in charge of research, General Electric Company; Dr. Abel Wolman, chief engineer, Maryland State Department of Health, Baltimore, and Dr. Harvey N. Davis, president of the Stevens Institute of Technology.

In the evening at 8:30 the ceremonies of the conferring of degrees by the University of Pennsylvania and the award of medals by the Franklin Institute will take place in Franklin Hall. There will be music by the Curtis Symphony Orchestra. A special program under the auspices of the Poor Richard Club of Philadelphia has been arranged for 2:30 on Saturday at which awards will be made to winners of an essay contest on "What Franklin Did for America and for Us Who Live To-day." The celebration will close with a banquet at the Bellevue-Stratford Hotel at which the Honorable Herbert C. Hoover will be the principal speaker.

Special exhibits in all departments of the museum showing the development of science from Franklin's day to the present, especially in the fields in which he was interested, will be placed on display beginning on May 19 and continuing for a limited period thereafter.

MEMBERS ELECTED BY THE NATIONAL ACADEMY OF SCIENCES

AT the annual meeting of the National Academy of Sciences held in Washington on April 25, 26 and 27 members were elected as follows:

Section of Mathematics:

Marshall Harvey Stone, Harvard University.

Section of Astronomy:

John Adam Fleming, Department of Terrestrial Magnetism, Carnegie Institution of Washington.

Section of Physics:

Carl David Anderson, California Institute of Technology.

George Walter Stewart, University of Iowa.

Section of Engineering:

Theodor von Kármán, California Institute of Technology.

Warren Kendall Lewis, Massachusetts Institute of Technology.

Section of Chemistry:

Carl Shipp Marvel, University of Illinois.

Worth Huff Rodebush, University of Illinois.

Section of Geology and Paleontology:

Walter Hermann Bucher, University of Cincinnati.

Section of Botany:

Lewis John Stadler, University of Missouri.

Section of Zoology and Anatomy:

Theophilus Shickel Painter, University of Texas.

Section of Physiology and Biochemistry:

William deBerniere MacNider, University of North Carolina.

Edward Adelberg Doisy, St. Louis University.

Section of Pathology and Bacteriology:

Simeon Burt Wolbach, Harvard University.

Section of Anthropology and Psychology:

Louis Leon Thurstone, University of Chicago.

Foreign members elected were:

Alfred Fowler, professor of astrophysics, Imperial College, University of London.

Pierre Janet, professor of psychology, College of France, Paris.

S. P. L. Sorensen, director of the chemical division of the Carlsberg Laboratory, Copenhagen.

D. M. S. Watson, Jodrell professor of zoology and comparative anatomy, University College, London.

Dr. F. K. Richtmyer, professor of physics and dean of the Graduate School of Cornell University, and Dr. E. D. Merrill, professor of botany, administrator of botanical collections and director of the Arnold Arboretum at Harvard University, were elected members of the council for a three-year term, beginning on July 1, 1938.

SCIENTIFIC NOTES AND NEWS

AT the recent meeting of the National Academy of Sciences, the Alexander Agassiz Gold Medal for contributions to oceanography was presented to Dr. Edgar Johnson Allen, for forty-two years director of the Plymouth Laboratory of the Marine Biological Association of Great Britain. The Public Welfare Medal for eminence in the application of science to the public welfare was presented to Dr. Willis R. Whitney, vice-president in charge of research of the General Electric Company. The presentation address for the Agassiz Medal was made by Professor Edwin G. Conklin, of Princeton University, executive vice-president of the American Philosophical Society, and the presentation address for the Public Welfare Medal was made by Dr. Albert W. Hull, of the General Electric Company, chairman of the committee that recommended the award.

THE John F. Lewis Prize of $300 and an illuminated diploma awarded "to the American citizen who shall announce at any general or special meeting of the American Philosophical Society and publish among its papers, some truth which the council of the society shall deem worthy of award" was given at its recent meeting to Professor Arthur J. Dempster, of the Uni-

versity of Chicago, in recognition of his work on mass spectroscopy and mass analysis of the chemical elements. The presentation of this prize was made at the annual dinner by Dr. Robert A. Millikan.

DAVID SARNOFF, president of the Radio Corporation of America, will be the recipient of the Marconi Memorial Award for 1939. The presentation will be made on April 25 of next year on the anniversary of Marconi's birth. Premier Mussolini has proclaimed the day a national holiday in Italy, and is personally contributing the medal bearing a likeness of Marconi.

DR. PAUL D. BARTLETT, assistant professor on the staff of Harvard University, will receive the $1,000 prize in pure chemistry awarded by the American Chemical Society in recognition of "notable progress in the important borderline field between organic and physical chemistry." The prize will be presented at the ninety-sixth meeting of the society in Milwaukee next September. The funds for the 1938 prize were donated by Professor James E. Kendall, head of the department of chemistry of the University of Edinburgh, "in appreciation of the facilities afforded him as a young chemist in America to engage in research work during fifteen years at Columbia and New York Universities."

THE Materials Testing Laboratory of the University of Illinois has been named the Arthur Newell Talbot Laboratory. Dr. Talbot, who has been connected with the university for sixty years, is said to have been responsible for the founding of the Engineering Experiment Station in 1903.

THE University of Oxford has conferred the degree of doctor of science on Dr. Harvey Cushing. Dr. Cushing was Moseley professor of surgery at Harvard University from 1912 to 1932, when he reached the retiring age. He was then appointed Sterling professor of neurology at Yale University, retiring in 1937. The title emeritus was conferred on him by both universities.

THE degree of doctor of laws was conferred on Dr. Alexander G. Ruthven, president of the University of Michigan, by the University of California on the occasion of the annual Charter Day exercises. The degree was presented by President Sproul, who made the following citation: "Able teacher and investigator of the intricate problems of animal life; skilled helmsman of the first state university to attain greatness and one to which we are united by many bonds; a modest, kindly, generous colleague."

AMONG the honorary degrees to be conferred by the Ohio State University at the commencement exercises on July 4 is the doctorate of science on Dr. Robert B. Sosman, physical chemist of the Research Laboratories of the U. S. Steel Corporation at Kearny, N. J., and on Professor Evan J. Crane, editor-in-chief of *Chemical Abstracts.*

DR. ALEXIS CARREL, member of the Rockefeller Institute for Medical Research, New York, was awarded on April 26 the honorary degree of doctor of science by Manhattan College, New York, on the occasion of its seventy-fifth anniversary.

DR. PEYTON ROUS, member of The Rockefeller Institute for Medical Research, New York City, has been elected a member of the Royal Academy of Sciences of Denmark in the class of the natural sciences and mathematics.

DR. S. WALTER RANSON, professor of anatomy at Northwestern University, was elected president of the American Association of Anatomists at the recent meeting in Pittsburgh. Dr. T. Wingate Todd, of the School of Medicine of Western Reserve University, was elected vice-president.

AT the annual meeting of the Electrochemical Society held at Savannah, Ga., the following officers were elected: *President,* Robert L. Baldwin, National Carbon Company, Niagara Falls, N. Y.; *Vice-presidents,* A. Kenneth Graham, Philadelphia; Leon R. Westbrook, Cleveland, and S. Skowronski, Perth Amboy, N. J.; *Managers,* R. B. Mears, New Kensington, Pa.; H. E. Haring, Summit, N. J., and L. C. Judson, New York City; *Treasurer,* Robert M. Burns, New York City; *Secretary,* Colin G. Fink, Columbia University.

AT Princeton University Professor Herbert S. Langfeld has been designated Stuart professor of psychology; Professor Charles W. Bray has been promoted to an associate professorship in psychology and Dr. Carl H. Wedell has been promoted to an assistant professorship.

AT Brown University, Dr. Paul C. Cross, of Stanford University, has been appointed associate professor of chemistry, and Dr. John P. Howe, of the Ohio State University, assistant professor of physical chemistry. Other appointments are Dr. John R. Lacher, of Harvard University, and Dr. Max F. Roy, of the University of Illinois, instructors.

DR. ROY SIMONSON, of the University of Wisconsin, has been appointed assistant professor of agronomy at the Iowa State College. Mr. Simonson will serve both the Experiment Station and the college, working in the field of soil research.

DR. JAMES N. PATTERSON, assistant professor of pathology of the College of Medicine of the University of Cincinnati, has been appointed director of the laboratories of the Florida State Department of Health at Jacksonville to succeed the late Dr. Paul Eaton.

TRUSTEES of Science Service were elected at the annual meetings on April 28 as follows: Dr. Ross G. Harrison, professor of biology and director of the Osborn Zoological Laboratory of Yale University, chairman of the National Research Council, to represent the council, and O. W. Riegel, director of the Lee School of Journalism, Washington and Lee University, and J. Edwin Murphy, managing editor of the *Sun*, Baltimore, to represent the journalistic profession. Dr. Robert Andrews Millikan, of the California Institute of Technology, was reelected a trustee as a representative of the National Academy of Sciences, and Dr. Henry B. Ward, of the University of Illinois, was reelected to represent the American Association for the Advancement of Science.

DR. JOHN C. MERRIAM, president of the Carnegie Institution of Washington, will be the speaker in the series on the "Social Implications of Science" on May 10 at the final dinner meeting of the season of the American Institute of the City of New York. The title of his address will be "The Application of Science to Human Affairs."

DR. GEORGE HOWARD PARKER, emeritus professor of zoology at Harvard University, will speak on May 9 at the American Museum of Natural History, New York City, on "Color Changes in Animals and the Neurohumoral Hypothesis."

DR. CARL VOEGTLIN, of the National Institute of Health, Washington, D. C., recently gave a course of three Herter lectures at the College of Medicine of New York University on "Some Chemical Aspects of the Cancer Problem" and on "Experimental Chemotherapy."

THE Calvin W. Rice lecture of the American Society of Mechanical Engineers will be given at St. Louis on June 21 at the semi-annual meeting of the society by William Robb Barclay, consulting metallurgist of the Mond Nickel Company, Ltd., of London.

DR. GEORGE GAMOW, professor of theoretical physics at the George Washington University, will go to Warsaw to take part in a symposium on "The New Theories in Physics," under the auspices of the International Institute of Intellectual Cooperation of the Congress of the League of Nations to be held from May 30 to June 4. He will sail from New York on May 17. The following papers will be presented: Professor Niels Bohr, Copenhagen, on "Indeterminist Interpretation of the Formal Structure of Quantum Mechanics"; Professor Louis de Broglie, University of Paris, "Relations Between Quantum Mechanics and the Theory of Relativity"; Professor Edwin Schrödinger, Graz, "Cosmological Applications of the Theory of Quanta"; Professor W. Heisenberg, Leipzig, "Quantum Theory of the Electromagnetic Field"; Professor P. A. M. Dirac, Cambridge, "Elementary Particles," and Professor Paul Langevin, University of Paris, "Positivistic and Realistic Currents in the Philosophy of Physics."

PROFESSOR JAMES W. COOK, of the Research Institute of the Royal Cancer Hospital, London, will be guest lecturer during the first term of the summer quarter in the department of chemistry at the University of Chicago. Subjects of these lectures will be: "Cancer Producing Chemical Agents and Their Biological Effects" and "Polycyclic Hydrocarbons and Their Relationship to Biological Problems."

THE Virginia Chapter of Sigma Xi held its annual spring meeting on April 11, when Dr. John Paul Nafe, professor of psychology at Washington University, St. Louis, spoke on the "Temperature Sense." At this meeting fifteen graduate students were initiated, and the president and visitors' research prize was awarded to Professors Piet van de Kamp, now at Swarthmore College, and A. N. Vyssotsky, for "the most outstanding piece of research of 1937."

AT the second annual meeting of the Association of the Southeastern Biologists, held at the University of Georgia, Athens, on April 15 and 16, under the presidency of Dr. G. H. Boyd, of the University of Georgia, a permanent organization was set up and the following officers were elected for the coming year: *President,* E. E. Reinke, Vanderbilt University; *Vice-president,* H. R. Totten, University of North Carolina; *Secretary-Treasurer,* D. C. Boughton, University of Georgia. Approximately a hundred biologists representing thirty-two institutions in Alabama, Florida, Georgia, North Carolina, South Carolina and Tennessee were in attendance. The program included twenty-one research papers and ten demonstrations in the fields of botany and zoology. The principal addresses were made by Dr. Otis W. Caldwell, general secretary of the American Association for the Advancement of Science, who spoke on "Research and Readjustment," and by Dr. F. G. Hall, of Duke University, whose subject was "A High Altitude Expedition."

THE annual meeting of the American Association of Museums will be held at Philadelphia on May 19, 20 and 21. Registration will be at 9 A. M. on the first day at the Pennsylvania Museum of Art, where the opening session will be held. Headquarters will be at the Warick Hotel.

THE twenty-sixth annual meeting of the Eugenics Research Association will be held at the American Museum of Natural History, New York City, on Thursday, June 2, at 10 A. M.

THE twenty-fourth annual meeting of the American Association of Cereal Chemists will be held at the Hotel Netherland Plaza, Cincinnati, from May 23 to

27. Dr. C. H. Bailey is president of the congress. The chairman of the program committee is George Garnatz, chief chemist of the Kroger Grocery and Baking Company, Cincinnati.

THE thirty-third annual meeting of the Southern Society for Philosophy and Psychology was held in Knoxville, Tenn., on April 15 and 16. Eighteen papers in philosophy and thirty-six in psychology were presented. New officers elected were: Frank A. Geldard, University of Virginia, *president;* C. Paul Heinlein, Florida State College for Women, *Secretary-Treasurer.* Elected to the council were: Herbert C. Sanborn, Vanderbilt University; Emily S. Dexter, Agnes Scott College, and James B. Miner, University of Kentucky.

SUBJECTS discussed at the Washington meeting of the Institute of Radio Engineers and the International Scientific Radio Union (American Section) included ionosphere and transmission phenomena and other phases of radio communication. On Thursday evening, April 28, there were semi-popular lectures with experimental demonstrations at the auditorium of the Department of Commerce, including "The Electric Performance of the Electric Eel" with demonstration, by C. W. Coates, of the New York Aquarium, and R. T. Cox, of New York University, and "Electromagnetic Waves in Free Space, in Metal Pipes and in Dielectric Wires" with an experimental demonstration, by George C. Southworth, of the Bell Telephone Laboratories.

THE conference of the Museums Association of Great Britain will be held in Belfast, Ireland, from July 4 to 9, under the presidency of Dr. R. E. Mortimer Wheeler. Information can be obtained from the Secretary, Chaucer House, Malet Place, London, W.C. 1.

AN International Engineering Congress will be sponsored at Glasgow, Scotland, from June 21 to 24, inclusive, by a number of engineering societies. This will be held during the progress of the Empire Exhibition. A detailed program, including several technical sessions, is being prepared. Those planning to attend the congress can obtain further details by writing to P. W. Thomas, honorary general secretary, 39 Elmbank Crescent, Glasgow, C. 2, Scotland.

THE International Congress on Technical Education will be held in Berlin from July 25 to 29 under the presidency of M. E. Labbé. It is proposed to discuss the following subjects: "The Human Aspect of Labor," "The Organization of Practical Training in Industry," "Contact between Methods of Work Employed in Technical and Vocational Schools and the Business and Technical World," "Recruitment of Principals of Vocational Schools," "Commercial Training of the Technician and the Technical Training of the Business Man," "Complementary Technical Instruction for Adults" and "The Technical Press and Technical Education." Those wishing to become members of the congress should notify M. R. Harlé, 2 Place de la Bourse, Paris, prior to June 15.

THE Committee on Scientific Research of the American Medical Association invites applications for grant of money to aid in research on problems bearing more or less directly on clinical medicine. Preference is given to requests for moderate amounts to meet specific needs. For application forms and further information, please address the committee at 535 North Dearborn Street, Chicago, Illinois.

DISCUSSION

INCITANTS OF HUMAN BOTULISM[1]

Cl. botulinum types A and B are apparently the only incitants of human botulism thus far described; types C and D have been reported only in outbreaks among various animal species. The identification of two type E strains, incitants of two fatal cases of human botulism in New York State, therefore, seems of interest.

One of the cultures was isolated from German-canned sprats, the other from smoked salmon which came from Nova Scotia; these strains have been found to be similar in cultural and biochemical properties. Their identification was made possible through the kindness of Dr. K. F. Meyer of the Hooper Foundation, San Francisco, who furnished neutralizing serum as well as transfers of two type E cultures which had been isolated from fish in Russia, where a considerable number of cases of botulism have resulted from eating improperly preserved fish. This information as well as the fact that our strains were obtained from fish prepared in Germany and Canada suggests that type E strains are widely distributed.

The possibility that such strains may have been overlooked in the past seems likely, since methods which are suitable for the detection of types A or B toxins in foods or for the production of toxin in broth cultures were found to be inadequate in this study.

Feeding large doses of the emulsion of the food substance to guinea pigs did not indicate the presence of botulinus toxin in the food, while small subcutaneous doses of the filtrate of the material produced symptoms of botulism in the animals, followed by death. The ratio of the fatal *per os* dose to the fatal subcutaneous

[1] From the Division of Laboratories and Research, New York State Department of Health, Branch Laboratory, 339 East 25th Street, New York, N. Y.

dose of the toxin for the fasting guinea pig was subsequently found to be roughly 220:1. Thus the importance of using the subcutaneous route of inoculation in addition to oral administration for detection of type E toxin in food substances is apparent. Cultures prepared from the German-canned fish and incubated at 37° C. were non-toxic for mice and guinea pigs in large doses. Only those which had been maintained at a temperature of 25–30° C. proved toxic to the animals.

It is important perhaps to mention that the two strains reported here, although similar immunologically and culturally, are not identical. They show distinct agglutinative properties. Furthermore, their toxins react differently in the chicken; young white leghorn chickens are highly susceptible to the toxin of the salmon strain but apparently insusceptible to that from the German-canned sprats.

ELIZABETH L. HAZEN

ANENT PARTHENOCARPIC APPLES

NAVEL apples[1] *Malus apetala,* falsely called bloomless or seedless, have gynomonoecious (purely pistillate) flowers, which have small green petals (hence are inconspicuous), lack nectaries (hence do not attract insects) and bloom after normal apples are normally through blooming. Navel apples, thus, stand slight chance of being pollinated, though a few belated normal blossoms may still persist to give pollen which the wind sometimes may waft to a navel flower. Navel apples are usually parthenocarpically developed. The Spencer (Seedless) navel is extremely fruitful in this way, the Wellington navel and the Navel No. 3 much less so, though over 90 per cent. of the fruit of these trees is also parthenocarpic. Yet, in three successive years at Arlington, Va., and one at Geneva, N. Y., over two thousand buds of Spencer, bagged (no pollination possible), *not one* fruit was parthenocarpically developed! A. B. Stout at Geneva, N. Y., during 1928 and 1929 had the same results: not one fruit developed from bagged buds. A similar test with Wellington and Navel No. 3 showed the same, save that those bags of Navel No. 3 which became aphid-infested set fruit 100 per cent. One year, a deliberate aphid infestation was made of bagged Spencer and Navel No. 3 buds. Not one Spencer developed, but Navel No. 3 set every bud of every spur! It was evident that the parthenocarpy was stimulative, but what was the stimulus? In 1934 I tried spraying trees with aphid extract, acetic and citric acids of varying concentrations. The results were nil.

In the spring of 1937, obtaining the suggestion from the work of Gustavson[2] like Gardiner and Marth,[3] I sprayed apple trees, my work being done at the Geneva, N. Y., station. The growth-substances were obtained from Dr. P. W. Zimmerman, of the Boyce Thompson Institute. The older Wellington trees having been destroyed and the younger trees too young to bear, I was limited to using only Spencer Navels of the parthenocarpic types, so I included such normal types as McIntosh, Sereda, Turley and Red Astrakhan. Of these forms the flowers were emasculated before blooming, before spraying and before bagging. Some branches with complete flowers left open were also sprayed. Indolacetic and naphthalene acetic were used in varying concentration even up to normal strength. In no case did fruit set occur, even with flowers left complete and open for pollination, among the Spencer navels or normal types. This corroborates the work of Gardiner and Marth, above mentioned.

F. A. VARRELMAN

DE PAUL UNIVERSITY

[1] A. B. Stout, N. Y. Bot. Garden *Bull.* No. 9, 1929.

[2] L. G. Gustavson, *Proc. Nat. Acad. Sci.,* 22, 622–636, November, 1936.

[3] Gardiner and Marth, SCIENCE, September 10, 1937, p. 246; *Bot. Gazette,* September, 1937, pp. 184–195.

THE SPEED OF INSECTS IN FLIGHT

IN a recent issue of SCIENCE[1] Langmuir has called attention to a story "going the rounds over the whole country" relative to the almost incredible speed of 800 miles per hour supposed to be attained by a deer botfly (*Cephenomyia pratti*). He has very effectually challenged the contention that this insect can attain such a speed. The present writer would like to call attention to certain experiments and observations that have been made in recent years relative to the speed of insects in flight.

Outstanding among the attempts to determine the speed of insects in flight is the work of Magnan.[2] He determined the maximum speed of 32 species belonging to 8 orders. This was done by two methods. One was to attach to the insect a thread that was wound around a small drum mounted on ball-bearings so as to allow the thread to be unwound by the insect in flight. Each revolution of the drum was electrically recorded along with the records of a chronograph. Since the length of thread unrolled at each revolution was known, it was easy to compute the speed of the insect in flight. The other method employed was to time the insect in flight as it passed between two markers at a measured distance using a chronometer, aided with the cinematograph.

Of the 32 species of insects employed by Magnan, the greatest speed was attained by *Anax parthenope,* a dragonfly, which traveled 8 meters per second, or approximately 17.9 miles per hour. The next highest

[1] I. Langmuir, SCIENCE, 87: 233–234, 1938.

[2] A. Magnan, "La Locomotion Chez les Animaux," *I–Le Vol des Insectes,* Hermann et Cie, Editeurs, Paris: 71–72, 1934.

speed attained was by *Aeschna mixta,* also a dragonfly, which made 7 meters per second. The third fastest was *Vespa crabo,* a wasp, which made 6 meters per second. Of the 5 species of flies used, the highest speed, 4 meters per second, was attained by *Tabanus bovinus,* a tabanid. Of the 5 species of beetles used, the highest speed, 2.5 meters per second, was recorded for *Melolontha vulgaris,* a chafer.

Magnan considered that these experiments did not give the full maximum velocity of the insects as they fly in nature. He held that the experiments indicated that certain insects would approach the speed of 10 meters per second.

Demoll[3] determined the speed of many species of insects belonging to 7 orders by timing them as they flew from the dark side of a room to a window on the opposite side. Of those insects used, hawk moths attained the greatest speed, that of 15 meters per second, or about 33.5 miles per hour. Next in speed came a tabanid, *Tabanus bovinus,* and a dragonfly, *Agrion.* Each of these attained a maximum speed of 14 meters per second. The greatest speed for a worker honeybee was 3.7 meters per second.

It is noted that there is a great difference in the determination of the maximum speed attained by insects of the same groups by these two experimenters. This difference also holds where the same species of insect was used by the two workers.

Tillyard[4] timed a dragonfly of the genus *Austrophlebia* over a measured stretch of between 80 and 90 yards, finding that it covered the distance in 3 seconds. This dragonfly, therefore, flew at a speed of nearly 60 miles per hour.

The results obtained by these three men indicate clearly that much more work is to be done before a final answer can be given to the question, "How fast can insects fly?"

H. E. EWING

U. S. NATIONAL MUSEUM

PASTEUR'S PATENTS

REGARDING the article which appeared in SCIENCE for October 8 under the signature of P. J. Federico, I would ask you, in my capacity of editor of the works of my grandfather—Louis Pasteur, kindly to refer your readers to foot-note 3, page 13 of volume III, "Etudes sur le vinaigre et sur le vin,"[1] in which note Pasteur explains why he took out patents.[1] See also note 1, page 410 of the same volume, where a reference to the patent taken by Pasteur for his process of manufacturing wine will be found. At the end of this note the words spoken by Balard (one of Pasteur's former teachers) before the Academy of Sciences, on February 27, 1872, regarding such patents may be quoted in translation: "This patent was taken by M. Pasteur when he had matured his process for preserving wine, in order to be guarded against undelicate people. He voluntarily allowed it to become public property, so those who speak lightly of this means of ensuring the property of an industrial discovery are therefore at liberty to freely make use of it." See also vol. V, "Etudes sur la bière," page 346 to 352.

PASTEUR VALLERY-RADOT

SOCIETIES AND MEETINGS

THE IOWA ACADEMY OF SCIENCE

THE fifty-second annual meeting of the Iowa Academy of Science was held at Morningside College at Sioux City, Iowa, on April 15 and 16 with 175 members and visitors in registered attendance. Members of the South Dakota Academy of Science were guests.

The presidential address, "Water Problems," was presented by Dr. A. C. Trowbridge, state geologist and professor of geology at the State University of Iowa. Other papers on the general program were "On the 'Curve of Deaths' and the Associated 'Curve of Lives.'" by Dr. H. L. Rietz, of the Department of Mathematics of the State University of Iowa, and "The Fir Forests of Iowa," by Dr. H. S. Conard, of the Department of Botany of Grinnell College. The annual address, "Science and Society," was presented by Dr. C. E. Friley, president of Iowa State College.

In addition to the general program, the academy met in nine sections for the presentation of 110 papers of special interest. A section on science teaching was initiated under the chairmanship of Dr. J. B. Culbertson, of Cornell College, Mt. Vernon, Iowa. The Junior Academy of Science of Iowa met with the academy with an attendance of delegates from eleven clubs. Dr. H. S. Conard, of Grinnell College, and Dr. George Hendrickson, of Iowa State College, presented talks on their program.

The following officers and section chairmen were elected for the next meeting, which will be held at Iowa State College at Ames, Iowa:

[3] R. Demoll, "Der Flug der Insekten und der Vögel," Jena: Gustav Fischer: 6, 1918.

[4] R. J. Tillyard, "The Biology of Dragonflies," Cambridge University Press: 322, 1917.

[1] In translation it reads: "As it frequently happens that scientific principles, when published by their authors, become in the hands of a third party, after being slightly modified or by the addition of a certain apparatus, the object of a patent, I (following the advice of duly qualified persons) applied for a patent, prior to publishing my paper in February, so that the same should be prior in date to any which my paper would give rise to; I may add that it is my intention not to make use of it."

President, J. N. Martin, Iowa State College; *Vice-president*, R. B. McClenon, Grinnell College; *Secretary-treasurer*, J. C. Gilman, Iowa State College; *Editor*, Mrs. F. W. Nichols, Ames; *Botany and Bacteriology*, G. F. Goodman, Iowa State College; *Chemistry, general and physical*, J. A. Coss, Morningside College; *Chemistry, organic and biological*, R. M. Hixon, Iowa State College; *Geology*, A. C. Trowbridge, State University of Iowa; *Mathematics*, E. E. Moots, Cornell College; *Physics*, R. W. Morrow, Iowa Wesleyan; *Psychology*, L. K. Henry, Iowa State College; *Science Teaching*, H. S. Conard, Grinnell; *Zoology*, Paul L. Risley, State University of Iowa.

JOSEPH C. GILMAN,
Secretary-Treasurer

THE PENNSYLVANIA ACADEMY OF SCIENCE

THE fourteenth annual meeting of the Pennsylvania Academy of Science was held at Bucknell University, Lewisburg, Pennsylvania, on Friday and Saturday, April 15 and 16. Much of the success of the meeting may be accredited to the hospitality of the university and the untiring efforts of its scientific staff, particularly Professor N. H. Stewart. About one hundred members attended. The program opened on Friday morning, at which time twelve papers on diverse topics were read. On Friday afternoon, the meetings split into two simultaneous groups for biology and geology. At the former, sixteen papers and at the latter also sixteen papers were listed. The meetings continued on Saturday morning. A zoological session included eleven titles, and at the same time a symposium on the teaching of science was held at which ten papers were listed. While the academy was in session, the junior academy assembled under the direction of Professor K. F. Oerlein. About one hundred and twenty-five members attended these meetings.

The annual dinner took place on Friday evening in the university dining hall. Both senior and junior academy members participated. After dinner, the entire group adjourned to Vaughan Literature Auditorium for the presidential address by Dr. George H. Ashley. Dr. Ashley spoke on "How Old is Man?" After tracing man's early history as revealed by fossil remains, Dr. Ashley commented upon man's relation to the last glacial retreat from Europe and North America and propounded reasons to show that the retreat was not necessarily simultaneous on both sides of the Atlantic Ocean.

At the regular business meeting the following officers were elected for the current year:

President: Dr. L. K. Darbaker, University of Pittsburgh.

Vice-Presidents: Jaques Cattell, Science Press; Professor E. A. Vuilleumier, Dickinson College.

Secretary: Dr. V. Earl Light, Lebanon Valley College.

Assistant Secretary: Charles E. Mohr, Reading Public Museum.

Treasurer: Professor H. W. Thurston, Pennsylvania State College.

Editor: R. W. Stone, Pennsylvania Topographic and Geologic Survey.

Press Secretary: Dr. Bradford Willard, Pennsylvania Topographic and Geologic Survey.

Junior Academy: Professor K. F. Oerlein, Indiana State Teachers College.

It has been decided to hold the 1939 meeting at Pennsylvania State College, and the 1940 meeting at Washington and Jefferson College. The summer meeting for 1938, the date to be announced, is to take place at West Chester to visit the serpentine barrens, famous equally for their peculiar botany, zoology and geology.

BRADFORD WILLARD,
Press Secretary

SPECIAL ARTICLES

ELECTROPHORESIS OF IMMUNE SERUM

ELECTROPHORETIC analysis of serum has indicated the existence of four definite protein components of different mobilities (albumin and globulin α, β and γ).[1] In rabbit antisera to crystalline egg albumin the antibody was found in the slowest migrating (γ) component.[1] Since antibodies formed in the horse and in the rabbit differ greatly in molecular weight,[2] a correlation of ultracentrifugal and electrophoretic studies seemed advisable.

Potent horse and rabbit Type I antipneumococcus sera, in which 20.7 and 18.6 per cent., respectively, of the total nitrogen was specifically precipitable, were dialyzed against buffer containing 0.02M phosphate and 0.15M NaCl and studied in the Tiselius electrophoresis apparatus.[3] The scale and Toepler "schlieren" methods were used for optical observation. The experiments were repeated under identical conditions with samples of the same sera from which the antibody had been removed by addition of the homologous type specific polysaccharide or by a heavy suspension of Type I pneumococci.[4]

The results were strikingly different in the sera of

[1] A. Tiselius, *Biochem. Jour.*, 31: 1464, 1937.

[2] M. Heidelberger and K. O. Pedersen, *Jour. Exp. Med.*, 65: 393, 1937; E. A. Kabat and K. O. Pedersen, SCIENCE, 87: 372, 1938.

[3] A. Tiselius, *Trans. Faraday Soc.*, 33: 524, 1937.

[4] M. Heidelberger and E. A. Kabat, *Jour. Exp. Med.*, 63: 737, 1936.

e two animals. The rabbit antiserum showed no idence of a new protein component, but there was increase in the amount of γ-globulin to 56 per cent. the total protein, as compared with 17 per cent. normal serum (determinations by the scale method). mparison with the electrophoretic diagrams obtained om the absorbed serum showed that specific precipiion removed 35 per cent. of the γ-globulin, whereas e other components were not markedly affected. 8.6 per cent. of the total protein concentration was us accounted for as antibody, in excellent agreement ith 18.6 per cent., the value obtained by direct analyis for antibody nitrogen.

The horse antiserum, however, showed a very strong ew component, migrating between the β- and γ-globuins, and this was no longer present in the sample rom which antibody had been removed (Fig. 1). The

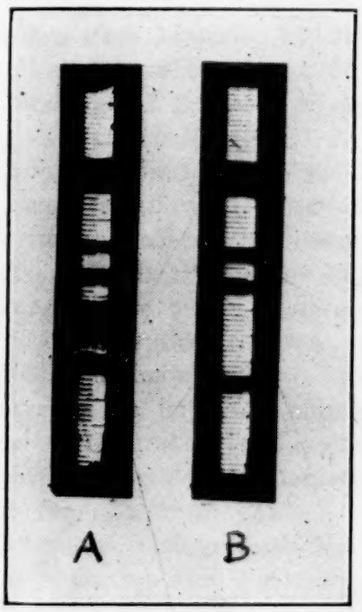

FIG. 1. Electrophoretic diagrams of unabsorbed (A) and absorbed (B) antipneumococcus horse serum.

mobilities of the other components in the absorbed nd unabsorbed sera were the same within experimental error as were the mobilities of normal sera in he same salt medium.

TABLE 1

MOBILITIES IN cm^2 sec^{-1} $volt^{-1} \times 10^5$ OF MAIN PROTEIN COMPONENTS OF IMMUNE HORSE AND RABBIT ANTISERA. TEMP. 0° C. BUFFER 0.15M NaCl, 0.05M TOTAL PHOSPHATE

	Albumin	Glob. α	Glob. β	Antibody	Glob. γ
Horse serum pH 7.71 ..	5.5	3.7	3.0	2.1	0.9
Rabbit serum pH 7.50 ..	5.9	4.3	3.3	..	1.2

The data in Table 1 are consistent with the observations of Heidelberger and Pedersen[2] and indicate that pneumococcus anticarbohydrate produced by the horse exists as a new component, while the same antibody as produced by the rabbit is an addition to the normal γ-globulin component of serum.

ARNE TISELIUS
ELVIN A. KABAT
Rockefeller Foundation Fellow, 1937–38
INSTITUTE OF PHYSICAL CHEMISTRY,
UNIVERSITY OF UPSALA, SWEDEN

AGGLUTININS FOR HUMAN ERYTHROCYTES IN TYPE XIV ANTI-PNEUMOCOCCIC HORSE SERUMS[1]

IN the course of clinical trials with therapeutic anti-pneumococcic horse and rabbit serums, unusual reactions sometimes leading to death were encountered in occasional patients receiving anti-pneumococcus type XIV horse serums. In one patient who recovered, hemoglobinuria occurred soon after an intravenous injection of type XIV horse serum. Bullowa[2] also has encountered fatal reactions with therapeutic type XIV serums. Experiments carried out in an attempt to elucidate the mechanism of these reactions revealed that the serums of horses immunized against type XIV pneumococci have agglutinins in high titers for human erythrocytes of all four groups. Agglutinins in low titers for human erythrocytes of each of the blood groups have been observed in normal horse serums,[3] and agglutinins for group AB and A cells have been noted in rabbit serums.[4] The latter have been shown to be in the nature of Forssman's antibodies.

The results of some of the observations made thus far are summarized briefly.

(1) Every one of nineteen different specimens of type XIV anti-pneumococcic horse serum agglutinated human red blood cells of all four blood groups in dilutions of 1:80 to 1:2560 of the serums. These serums were obtained from three different laboratories and were produced by immunization with at least three different strains of type XIV pneumococci. They included monovalent and bivalent (some with type VI and others with type XIX), concentrated and unconcentrated serums. In the concentrated serums the titers of agglutinins for the blood cells of each group were higher than the corresponding titers in the unconcentrated serums from which they were prepared. Erythrocytes from different individuals of the same blood group were agglutinated to the same titer in the same type XIV horse serum. Hemolysins

[1] From the Thorndike Memorial Laboratory, Second and Fourth Medical Services (Harvard), Boston City Hospital, and the Department of Medicine, Harvard Medical School, Boston, Mass.

[2] J. G. M. Bullowa, "The Management of the Pneumonias." New York, Oxford University Press, 1937, p. 316.

[3] V. A. Herman, *Jour. Immun.*, 31: 347, 1936.

[4] G. H. Bailey and N. S. Shorb, *Am. Jour. Hyg.*, 13: 831, 1931; 17: 329 and 358, 1933; C. A. Stuart, *et al.*, Jour. Immunol., 31: 25, 1936; O. Thomsen, *Ztschr. Immunitatsforsch.*, 87: 335, 1936; M. Eisler, *ibid.*, 88: 240, 1936.

for human erythrocytes could not be demonstrated in these serums by the usual methods.

(2) Among 41 samples of anti-pneumococcic horse serums of types other than type XIV, only two agglutinated human erythrocytes in a dilution of 1:20 or higher. One concentrated bivalent type V and VII horse serum and one unconcentrated type IX horse serum agglutinated human group B erythrocytes in dilutions of 1:40 and 1:20, respectively. These forty-one serums included at least one specimen of serum for each of the twenty-nine other available specific pneumococcus types. Sixteen of them were concentrated preparations.

(3) Ten samples of different type XIV anti-pneumococcic rabbit serums were obtained from the same three laboratories as supplied the horse serum. These rabbit serums were prepared with the same strains of type XIV pneumococci as were used in making the type XIV horse serum. None of these rabbit serums agglutinated human group B or group O cells (1:5 dilution was the lowest tested), but four agglutinated both AB and A human erythrocytes in dilutions of 1:20 to 1:80. Among twenty rabbit anti-pneumococcic serums of eleven types other than type XIV, eight showed agglutinins for human AB and A in titers of 1:10 to 1:160, but none agglutinated either group B or group O cells. The agglutinins for groups AB and A human erythrocytes in the various anti-pneumococcic rabbit serums, both type XIV and those of other types, were associated with agglutinins and hemolysins for sheep erythrocytes and could be absorbed with sheep red blood cells.

(4) After sufficient absorption with type XIV pneumococci to remove the homologous pneumococcus agglutinins, no agglutinins could be demonstrated, in the type XIV anti-pneumococcus horse serums, for human erythrocytes of any of the four blood groups. Absorption with human erythrocytes of each of the four groups completely removed the agglutinins for human red blood cells of the homologous and of the three heterologous blood groups, but left the type XIV pneumococcus agglutinins essentially unchanged. Large amounts of erythrocytes were necessary to carry out these absorptions.

The details of these observations and of further experimental studies will be reported elsewhere.

MAXWELL FINLAND
EDWARD C. CURNEN

PREPARATION OF PURE D-ARGININE

ALTHOUGH the best method for preparation of pure arginine derivatives appears to be through the flavianate isolation, as introduced by Kossel and Gross,[1] and subsequently improved[2, 3] to give a high-pur arginine hydrochloride, none of these papers prese details for the obtainment of free base d-arginin Another article[4] has described an unsuccessfull atte to convert the hydrochloride into pure arginine ba

The essential precautions for obtaining pure d-arg nine from the hydrochloride now appear to be th choice of a satisfactory protein source, and the re moval of arginine-silver complex from the final fr arginine solution, since the arginine-silver compler i soluble in solutions of arginine.[5] Satisfactory prote sources include salmine and gelatine of U. S. P. gra or better. Casein, hog's blood and defatted can sardine spermatic tissue were found to be unsati factory.

For the preparation of d-argininium chloride, th classical method of Brand and Sandberg[3] was fo lowed, except that it was imperative to dilute 39 m of 5 N HCl in 300 ml of water in hydrolyzing 50 g batches of benzylidene arginine. For the hydroly of commercial salmine, seven parts of concentrate HCl (S.G. 1.19) sufficed.

In an exemplary preparation of free base d-arg nine, 8.03 gm of silver nitrate (3 per cent. excess ov the arginine hydrochloride requirement) was dissolv in 50 ml of water and treated with 50 ml of 2N NaO The precipitated silver oxide was washed until th washings were neutral, and the silver oxide was the transferred to a solution of 9.66 gm of argini hydrochloride in 50 ml of water, with aid of th wash-bottle. The mixture was stirred mechanical for ten minutes, and the silver chloride filtered o The filtrate was saturated with hydrogen sulfid boiled, and the coagulated silver sulfide filtered o The filtrate from this operation was evaporated t dryness under reduced pressure on the water bath i a stream of carbon dioxide-free air. The residue w dissolved in 20 ml of boiling water, and placed in desiccator over sodium hydroxide. When the solutio had cooled, the desiccator was evacuated. The yie was 7.84 gm of arginine, melting at 228° (corr.) wi dec. This corresponds to 98 per cent. recovery fro the hydrochloride. Recrystallization from 16 ml of h water and 40 ml of freshly boiled absolute ethan gave a 96 per cent. recovery.

No difficulty was experienced in crystallizing arg nine prepared from salmine or gelatine. One crys of 3 cm length was obtained by slow evaporation o the solvent during two weeks. Arginine solutio

[1] A. Kossel and R. E. Gross, *Zeit. Physiol. Chem.*, 135: 167, 1924.

[2] P. Brigl, R. Held and K. Hartung, *Zeit. Physi Chem.*, 173: 151, 1928.

[3] E. Brand and M. Sandberg in F. C. Whitmo "Organic Syntheses," 12: 4, 1932.

[4] E. Schulze and E. Steiger, *Zeit. Physiol. Chem.*, 1 43, 1887.

[5] W. Gulewitsch, *Zeit. Physiol. Chem.*, 27: 178, 1899.

om the other sources mentioned above sometimes quired addition of carbon dioxide-free ethanol in der to cause crystallization.

Arginine absorbs carbon dioxide from the air, but is may be driven off by boiling the solution of crystallization.

SIDNEY W. FOX

WILLIAM G. KERCKHOFF LABORATORIES
OF THE BIOLOGICAL SCIENCES,
CALIFORNIA INSTITUTE OF TECHNOLOGY

AILURE OF ALFALFA TO PREVENT THE HEMORRHAGIC SWEETCLOVER DISEASE[1]

IN 1922, Schofield[2] showed that the feeding of poorly ured sweetclover hay may induce in the bovine a dis- se characterized by a diminished clotting power of e blood. The disturbance of the clotting mechanism s since been found to be due to a deficiency in pro- rombin.[3,4] Continued administration of a toxic diet sults in severe, usually fatal hemorrhage.

In a recent paper on one phase of this problem, Quick[5] concludes from experiments with rabbits that "Diet is the important means for controlling the dis- se. The incorporation of 5 per cent. of dehydrated lfalfa meal with the toxic hay was found sufficient to prevent the development of the disease or even any emonstrable reduction of prothrombin." It is also tated that "The animal appears to be able to store his accessory factor [from alfalfa], for it is very fficult to produce sweetclover disease in animals hat have been fed relatively large amounts of alfalfa. his explains why some animals are far more resistant han others to the same lot of spoiled hay." Quick oints out the practical significance of these conclu- ions and suggests the relation of this accessory factor o the anti-hemorrhagic vitamin K which is required by the chick for normal blood coagulation and is pres- nt in alfalfa. These conclusions, of significance in agriculture and in studies of factors affecting the mechanism of blood coagulation, are not in agreement with the results of our experiments with rabbits. The details of these experiments will be recorded elsewhere, but the salient features will be presented at this time.

We have found no indication that alfalfa exerts a protective action against the sweetclover disease. Rabbits have been fed alfalfa to the amount of 50 per cent. of the diet along with toxic hay and toxic extracts. Nevertheless the symptoms of the disease have appeared. Freshly cut alfalfa constituting 12.9 per cent. (dry weight) of the ration and kiln-dried alfalfa constituting 10 per cent. each in a diet of toxic hay failed to inhibit the action of the toxic principle. Likewise a commercial alfalfa hay of excellent quality when incorporated to the amount of 10 per cent. in a toxic hay was ineffective in checking the onset and fatal termination of the disease.

A marked variation within a group of rabbits of similar age in reaction to a given toxic hay has been observed in our experiments. Animals found susceptible in a preliminary test on a uniform diet have maintained their susceptibility in further subjection to the action of the toxic principle. In like manner resistant animals in as far as they have been tested have been resistant in later trials on the same hay. Furthermore, no significant differences have been observed between groups of rabbits having had alfalfa or no alfalfa during the period prior to a test on toxic hay. These and related considerations arising from experiments on some 150 rabbits suggest that the variation in a group of rabbits in reaction to a given toxic hay is due to the inherent characteristics of the animals; there is no evidence in our experiments that the variation results from previous feeding.

WILLIAM K. SMITH

BUREAU OF PLANT INDUSTRY AND
UNIVERSITY OF WISCONSIN

SCIENTIFIC APPARATUS AND LABORATORY METHODS

STATIC ELECTRIC PROPERTIES OF A NEW BAKELITE PLASTIC

RECENTLY the Bakelite Corporation has put on the market a new plastic designated as polystyrene XMS–10023. It was described as an excellent electric insulator. In the search for some material that could be used as insulator in static electric experiments the writers tested this material by electrometric methods. While amber has all the desirable properties for an insulator it is rather expensive and, particularly, not easily obtainable in larger dimensions. XMS–10023 can be molded readily into any given shape without restriction as to size.

The electric resistivity was compared to that of amber and of a shellac-coated hard rubber, with the approximate relative results shown in the following table:

[1] Contribution from the Department of Genetics (Paper No. 226), Wisconsin Agricultural Experiment Station in cooperation with the Division of Forage Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture. Cooperative investigations with the Biochemistry Research Laboratory, Department of Agricultural Chemistry, Wisconsin Agricultural Experiment Station.

[2] F. W. Schofield, *Can. Vet. Record*, 3: 74–78, 1922.

[3] L. M. Roderick, *Am. Jour. Physiol.*, 96: 413–425, 1931.

[4] A. J. Quick, *Jour. Biol. Chem. Proc.*, 114: lxxxii, 1936.

[5] A. J. Quick, *Am. Jour. Physiol.*, 118: 260–271, 1937.

Amber	1
XMS–10023	1: 3
Hard rubber	1: 50–140

If, therefore, amber has a resistivity of $10^{-18}\Omega$/cm, XMS has about $3\times10^{-17}\Omega$/cm. The new material ranks very close to amber in its insulating qualities and will in many cases be a very good substitute for it. Its resistivity is equal to or perhaps a little higher than quartz, but the ease of molding it will make it superior to quartz. Whereas amber insulators are usually flamed to remove surface charges, XMS–10023 will charge itself when brought into the flame. Cleaning with alcohol will suffice to make it ready for use.

For atmospheric electric and Radon measurements the qualities of this plastic seem to be quite satisfactory.

H. LANDSBERG
A. I. INGHAM

THE PENNSYLVANIA STATE COLLEGE

A NEW METHOD FOR MARKING SMALL LABORATORY ANIMALS

VARIOUS methods are utilized in different laboratories to facilitate the identification of individual animals. Large mammals, such as cats, dogs and rabbits, are frequently kept in individual living cages and under such conditions identification marks may not be needed. This is not always the case when an experimenter is using rats as his subjects. In many laboratories from ten to one hundred rats are kept in the same living cage and it is always useful and frequently essential to be able to select accurately one particular animal from this number.

Perhaps the most popular method of marking rats is that of mutilating the ears. Usually the ears are notched or perforated with a small punch. A third and less common procedure is to amputate the toes of the hind feet in various combinations, and even to cut off a portion of the tail. All the above methods have serious drawbacks if they are to be applied to a large number of rats which are to be marked for a long period of time. In addition to difficulties arising from healing and regeneration of the mutilated tissue, any one of these methods involves the necessity of teaching laboratory assistants the pattern of combinations used to designate the various numbers.

The writer has found that one extremely simple and practical method of marking rats is to tattoo the identification numbers in the ear. The principle of the machine used is very simple and the laboratory worker can construct his own tattooing outfit. However, machines can be purchased so cheaply that it is scarcely worthwhile to attempt their construction. A machine used to mark rats in this fashion can be purchased in any large city for $3 or $4 in an establishment where tattooing is performed. The apparatus is that used to tattoo designs in human flesh. The ... satisfactory material for putting the numbers in ... ear is india ink.

In the writer's laboratory are several animals w... identification numbers tattooed in their ears six mon... previously. These marks show no signs of fading, a... experience with designs tattooed in human skin in... cates that a number once tattooed into the rat's e... will remain legible throughout the animal's lifetim... The application of this method of marking is of gre... assistance if one wishes to keep a genetic record in co... nection with breeding in the colony. Young rats c... be marked for life at the time of weaning.

FRANK A. BEACH, JR.
AMERICAN MUSEUM OF NATURAL HISTORY

THE USE OF COTTON TO ABSORB BLOOD FOR CHOLESTEROL EXTRACTION

THE determination of cholesterol in blood with t... micro extraction apparatus previously described[1] ... facilitated by substituting absorbent cotton for t... filter paper. A quantity of absorbent cotton is was... several times with fresh portions of chloroform, a... dried in the air to remove fatty contaminants. A sm... piece of cotton is tamped into the extractor with a gl... rod. The upper end of the cotton should be about 2... cm from the open end. The tip of the blood-fill... pipette is firmly pressed into the cotton, which th... absorbs the blood quantitatively. A second, small... piece of cotton is tamped against the blood-soaked co... ton, and the drying and extraction are performed a... cording to the original directions.

The apparatus now has a cylindrical glass shie... This protects the extraction tube from draughts a... permits the operation of the heating element with ... smaller current, thereby prolonging its life.

E. M. ABRAHAMSON

BROOKLYN, N. Y.

[1] SCIENCE, 86: 477, 1937.

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